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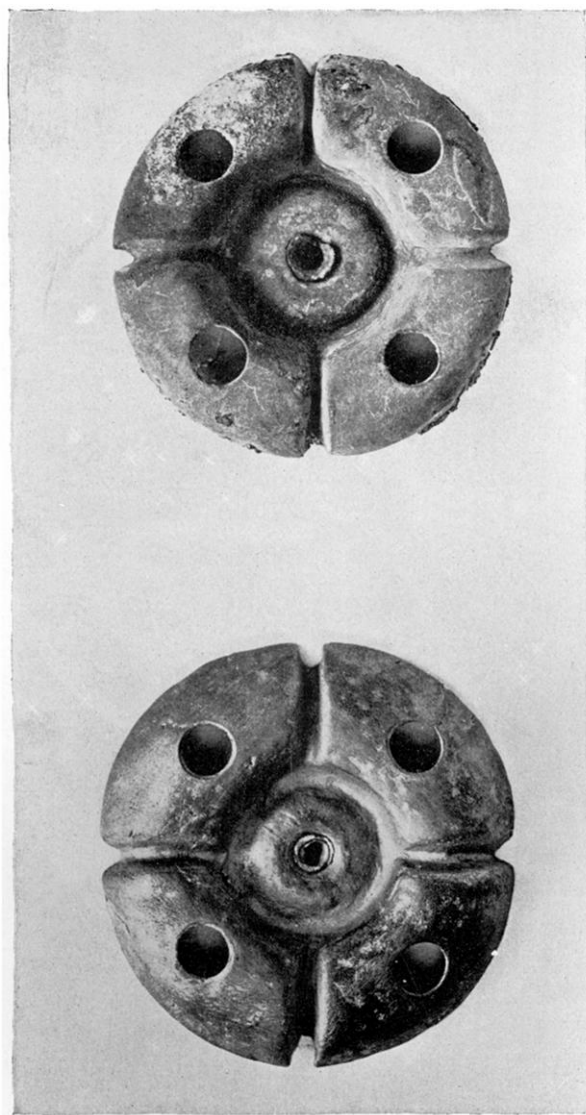
PRIMITIVE METAL WORKING

By CHARLES C. WILLOUGHBY

Apropos of the discussion at the recent meeting of the American Association at Washington of the sheet-copper objects from the mounds, a brief account of an experiment in native copper working with primitive tools, made by the writer in 1894, may not be without interest. Only two trials were made to form sheets from native copper, both of which were successful. The first sheet produced was from a nugget from an altar of an Ohio mound, the second was from native copper from the Lake Superior region. But one attempt was made to form an ornament from a sheet of copper thus produced, the result of which is shown in *b* of the accompanying plate XI. The upper figure (*a*) of the same plate represents half of an ear-ornament from an extensive deposit of copper objects in a mound of the Hopewell group, Ohio. Although larger and more elaborate ornaments were found, this object was chosen for reproduction because its construction from a nugget of native copper involved all the various processes necessary for making any object of metal from these mounds—hammering, annealing, grinding, cutting, embossing, perforating, and polishing.

The experiment was carried out upon a sea-beach strewn with water-worn stones of all sizes. Placing upon a smooth stone a piece of native copper from the Lake Superior region, and using an oval water-worn stone as a hammer, the copper was carefully beaten. A few blows sufficed to show the tendency of the copper to crack along the edges as it expanded. This tendency was overcome by annealing. It was only by careful hammering and repeated annealing that the mass was formed into a thin sheet. When the sheet had attained the required size it was ground to a uniform thickness between two flat stones, the work being hastened by the addition of fine sand.

The sheet was cut into circular form by incising partly through the copper with sharp flints and breaking off the superfluous metal.



PRIMITIVE COPPER WORKING

a, Part of a copper ear-ornament from a mound of the Hopewell group, Ohio. *b*, Modern copy of the above made by primitive processes.

The rough edges were then ground smooth on stones. As the four disks forming the pair of ornaments which served as a pattern were remarkably alike in size and contour, and appeared to have been made over the same mold, a modern form of the required shape was constructed from a piece of driftwood by charring and scraping and cutting with sharp flints. Over this form the copper disk was molded by light hammering and by pressure, the burnishing and pressing tool being made from a splinter broken from a beef-bone found on the beach. During the pressing and embossing process it was necessary to anneal the copper several times in a small fire kindled upon the sand. The perforations were made by using a rudely chipped flint as a drill and reamer. The ornament was polished with fine sand, and afterward with wood ashes.

The remarkable objects wrought from copper, silver, and meteoric iron from the Turner and Liberty groups, Ohio, on exhibition in the Peabody Museum at Cambridge, and those from the Hope-well group in the Field Columbian Museum at Chicago, should be carefully studied by all students interested in primitive metal working. These collections include nuggets of meteoric iron,¹ copper, and silver, most of them hammered to a greater or lesser degree. Among the finished implements and ornaments are celts and small cutting tools of copper and meteoric iron; head, breast, and other personal ornaments of copper, meteoric iron, and silver, and spool-shaped ear-ornaments of copper, some of which are overlaid with thin sheets of meteoric iron or silver. Symmetrical hemispheres of clay from half an inch to two inches in diameter were very neatly covered with thin sheets of meteoric iron, copper, or silver, the plate of metal on the flat side of the ornament having two perforations for attachment. Many symbolic designs cut from thin copper are also in the collections,² and to a student of the higher symbolism of the American Indian these designs are of themselves sufficient proof of the native origin of the objects.

A dozen or more small sheets of gold hammered from small

¹ For notices of meteoric iron from the Ohio mounds, with drawings and analyses, also for a brief account of the objects from the Turner group, see Professor Putnam's notes in *Peabody Museum Reports*, vol. III.

² See *Proceedings of the American Association for the Advancement of Science* for 1895, p. 302.

nuggets, but otherwise unworked, were taken from one of the altars of the Turner group and may be seen at the Peabody Museum. With this fact in mind, one should not too hastily question the statements of early writers that gold objects have been taken from the Ohio mounds. The more important evidences tending to show that the sheet-metal objects noted above are of prehistoric origin, may be summed up as follows :

1. The extensive prehistoric mines where native copper and silver were obtained.

2. The occurrences in the mounds of native copper and silver in nuggets, both worked and in their natural state, in company with ornaments from thin sheets of the same metals.

3. The ornaments from the Turner, Hopewell, and Liberty groups are strictly of native design.

4. The motifs of the symbolic forms expressed in the designs of many of the objects are the same as those occurring in objects of bone, shell, and stone throughout a large portion of America.

5. The simple art of forming sheets of copper, silver, and gold (as well as the more advanced arts of metallurgy) was known and practised by the cultured tribes of the Peruvian region in prehistoric times. It is not probable that any archeologist will claim that the thin sheets from which many of the prehistoric Peruvian ornaments were cut, large though some of them were, were rolled by machinery, or that any processes other than those of hammering, annealing, grinding, embossing, and perforating were followed in their construction.

6. Practical demonstrations have shown that any of the metal objects from the above mounds could have been made by processes known to the Indians at the time of their first contact with whites.¹

7. There is no evidence whatever of the European origin of the sheet-copper from the Turner, Liberty, or Hopewell groups, or that the mounds themselves are of post-Columbian date.

¹ That the Indians of the low grade of culture of the northern Athapascans understood the art of annealing is shown by a passage in Hearne's narrative of his journey to Coppermine river in 1771. Writing of the native copper of that region, he says : " By the help of fire, and two stones, they can beat it out to any shape they wish."—Samuel Hearne, *A Journey to the Northern Ocean*, p. 175.